Introduction to Programming with Python

Course: CSE 1100- Introduction to Computing I

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Objectives

- At the end of this lecture, students should be able to:
  - perform calculations using standard arithmetic operators
  - use variables to store values
  - describe differences between int and float types
  - print numbers and strings to standard output

Programming

- A program is a sequence of instructions which performs a specific task
  - Instructions are specified in a sequence
  - Computers execute the instructions one after the other

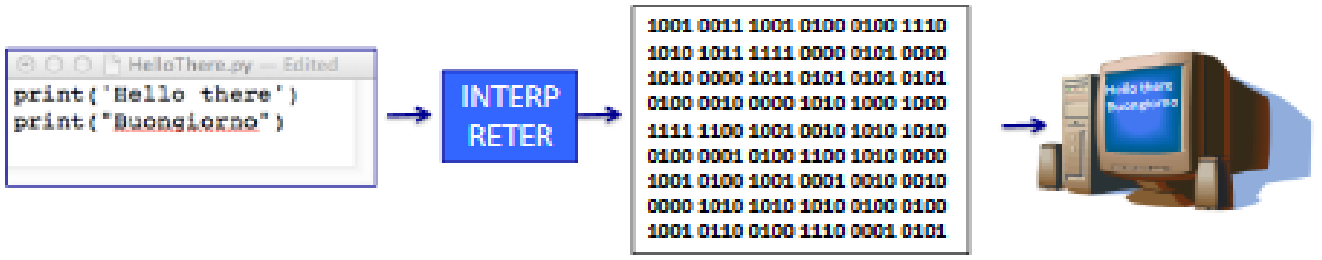
  Instructions are specified using a formal language
  - Natural languages are the languages spoken by people
  - Formal languages are designed by people for a specific purpose, e.g., mathematical notation, chemical structure of molecules, programming languages
  - In this course we will be using the Python 3 programming environment

Programming – The Python Interpreter

Source code (programs) is written in a programming language such as Python.

The Python **interpreter** translates and **executes** source code

- One instruction at a time is converted into machine code and executed by the interpreter.

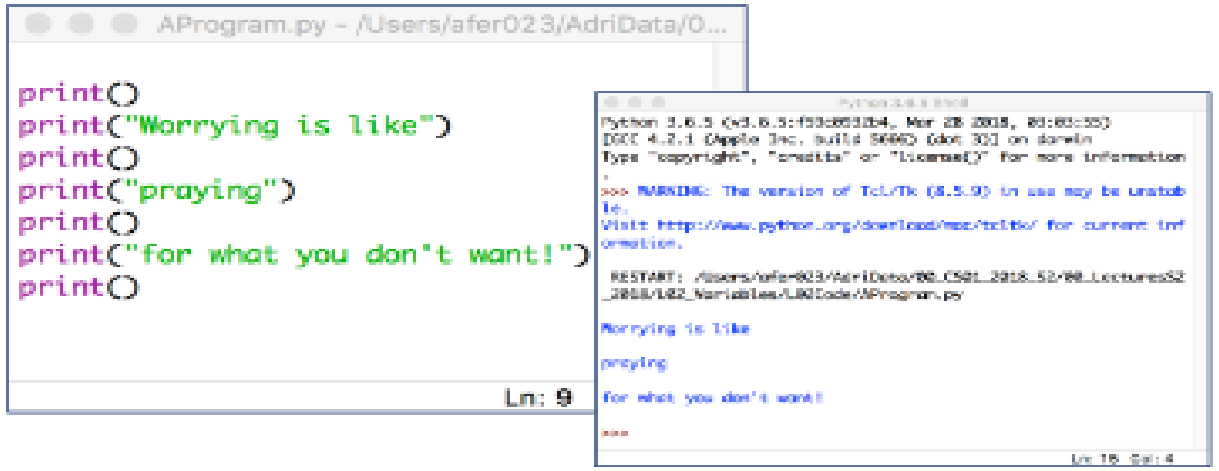


Python Programming Environment (IDLE)

IDLE

IDLE (**Integrated DeveLopment Environment**) is an integrated development environment for Python. This is the development environment provided when you download Python.

This is the environment we will be using to write and execute our Python programs.



Python Programming Environment (IDLE)

Programs are deterministic :

- the result of the program instructions is well defined,
- rules govern the results of instructions. Once we learn the rules, we can govern what the computer does,
- the output is completely predictable

Storing Information - Variables

Variables are names for storage locations

- Almost any name will work – **but there are some constraints**
- A variable stores only one value at a time
- Assign a value to a variable location using **=** (the **assignment operator**)
- Refer to the value in a location using the variable name.

Three variables used to store three pieces of information.

```
name = "Adriana"
height = 170.0
age = 21
```

Variables Names

The following are **valid** variable names:

```
x
age
age_of_child
box1
box_2
_age
age_
```

The following are **invalid** variable names:

```
3
age of child
age-child
1st
2_box
```

What are the rules for naming variables?

Variables Names Conventions

Always choose variables with meaningful names:

```
name
age
course
```

The convention when using multiple words, is to join words with an underscore:

```
user_input
age_allowed
age_of_child
circle_area
```

The convention is to use lower case letters for variable names.

Python is case sensitive. For example, the variable, age, is not the same as the variable, Age.

Keywords

Variable names should not be keywords (also called **reserved words**):

and	elif	import	raise
as	else	in	return
assert	except	is	try
break	finally	lambda	while
class	for	nonlocal	with
continue	from	not	yield
def	global	or	
del	if	pass	

Types of Information

What kind of information can our programs store?

Information in a program is categorised into different types. There are four basic types in Python:

- integer
- floating point
- string
- boolean

Integer values are numbers with no decimal point. They can be positive, 0 or negative:

```
202
0
-32
```

Floating point numbers are numbers with decimal points. They can be positive, 0 or negative:

```
1.0
-3.405
0.0
3.3333333
```

Note that the precision of floating point numbers is limited.

Assigning Information to Variables

The assignment operator = is used to assign a value to a variable, i.e., to store some information in the program memory:

```
result1 = 54
my_age = 21
bank_balance = 2019
```

The left hand side of the assignment operator is always a variable.

Doing Calculations

The following mathematical operators can be used with integers and with floating point numbers:

- Addition `+`
- Subtraction `-`
- Multiplication `*`
- Division `/`
- Exponentiation `**`

```
result1 = 54 + 4
result2 = 15 / 5
bank_balance = 2019 * 2
solution = 4 ** 3
```

Expressions

An expression always evaluates to a single value, e.g.,

- -3 + 5
- 6 * 2 + 1
- 52 – 3 * 2.3
- 4.6

The right hand side of an assignment statement is always an expression.

```
result1 = 54 + 4 / 5
result2 = 15 / 5
bank_balance = 2019 * 3 / 100
age = 1 + 2 + 1 + 1
result3 = 7
```

Firstly the expression on the right hand side of the assignment operator is evaluated, and, then, the resulting value is assigned to the variable on the left hand side of the assignment operator.

Expressions

An expression can be used anywhere a single value can be used.

A variable can be used anywhere a single value can be used.

```
result1 = 54 + 4 / 5
result2 = result1 / 10
bank_balance = 2019 * 3 / result2

age = 5
age = age + 4
age = age * 3
```

Standard Output - Printing

The print() function is used to print values to the standard output.

- `print(45.67)`
- `print(100000)`
- `print(44)`

Notice that round brackets (parentheses) are used with functions. After printing whatever is to be printed (whatever is inside the round brackets), a new line is printed, i.e., the pen moves to the next line.

```
principal = 100
years = 15

print(43)
print(principal)
print(2 * years + 1)
```

```
43
100
31
```

Standard Output - Printing

The print() statement with no arguments simply prints a blank line.

```
principal = 100
years = 15

print(43)
print()
print(principal)
print()
print()
print(2 * years + 1)
```

```
43

100


31
```

An Example Program in Python

The formula for working out the final amount when a sum is invested at compound interest is: $M = P(1 + i)^n$ where:

- M is the final amount including the principal.
- P is the principal amount.
- i is the rate of interest (a whole number indicating the % interest) per year.
- n is the number of years invested.

Complete the code which calculates the final amount when $100 is invested for 15 years at 10% compound interest. The output prints the principal on one line followed by the final amount on the next line:

```
principal = 100
years = 15
rate = 10
final_amount =
```

```
100
417.7248169415656
```

Strings – Python built-in type

A string consists of a collection of characters delimited by single quotes (' ... ') or by double quotes (" ... "), e.g.,

- "Meravigioso"
- 'The final result is:'
- "5 + 2 * 5"
- ""

The program from the previous slide could be written with more information in the output:

```
principal = 100
years = 15
rate = 10
final_amount = principal * (1 + rate /100) ** years
print("Initial amount")
print(principal)
print("Final amount")
print(final_amount)
```

```
Initial amount
100
Final amount
417.7248169415656
```

Printing Multiple Values in Line

The print() statement can be used to print more than one variable (or value) on a single line. Each value to be printed is separated by a comma, e.g.,

- print(1, "Meraviglioso", "Fabulous")
- print('The final results are:', 56, "and", 44)

```
1 Meraviglioso Fabulous
The final results are: 56 and 44
```

The default separator between the items to be printed is a single blank space, e.g.,

```
principal = 100
years = 15
rate = 10

final_amount = principal * (1 + rate /100) ** years
print("Initial amount", principal)
print("Final amount", final_amount)
```

```
Initial amount 100
Final amount 417.7248169415656
```

Summary

Examples of Python features used in this lecture

- use variables to store values, using valid variable names

```
principal = 100
years = 15
rate = 10
```

- perform calculations using standard arithmetic operators

```
final_amount = principal * (1 + rate / 100) ** years
```

- describe differences between int and float types

```
years = 15
rate = 0.01
```

- print numbers and strings to standard output

```
print("Final amount $", final_amount)
print()
print("Final amount $", final_amount, sep = "")
```

In a Python program we can:

- use variables, which have valid variable names, to store values,
- perform calculations using standard arithmetic operators
- describe differences between int and float types
- print numbers and strings to standard output

End of Lecture!!!